# Fleet Models for the Marine Life Protection Act

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# Why do we need a fleet model?

- Biomass dynamic models seek to predict ecological effects of regional marine protected area (MPA) proposals
  - Space is broken into 1 km<sup>2</sup> discrete "patches"
- Ecological effects depend on spatial fishing effort outside MPAs
  - How is effort currently distributed?
  - Where will effort go after MPAs implemented?

#### How do fleets behave?

- "Effort" = time fishing to achieve given fishing mortality
- Spatial fishing effort responds to:
  - Fish densities (adult biomass)
  - Distance from port
  - Fishing conditions/weather
  - Others' fishing effort in the patch
- Effect of each variable may differ across:
  - Fleets (commercial, recreational)
  - Species

### "Value" of fishing a patch

$$\pi_{i} = \alpha_{1} f(E_{i}, B_{i0}) - [\alpha_{2} D_{i} + \alpha_{3} W_{i} + \alpha_{4}] E_{i}$$

- Where
  - /indexes a patch
  - B is current adult biomass
  - *E* is effort
  - f(B,E) is harvest
  - D is distance
  - W is weather

 $\square \alpha_{1} \dots \alpha_{4}$  are parameters

#### How is effort distributed?

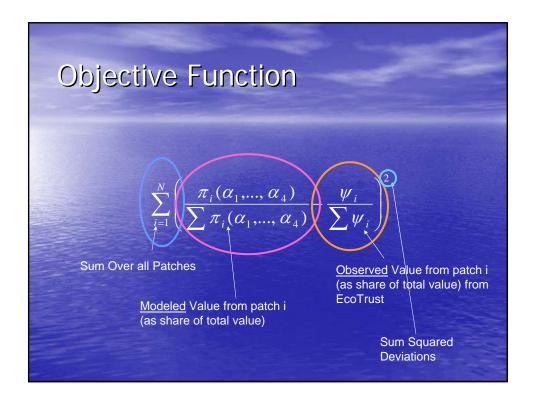
- We assume fishermen choose to fish the patches that will return <u>highest value</u>
- Marginal value is:

$$\frac{\partial \pi_i}{\partial E_i} = \alpha_1 f'(E_i, B_{i0}) - \alpha_2 D_i - \alpha_3 W_i - \alpha_4$$

All fished patches have equimarginal value

## Fitting model parameters

- How do we know the value of the parameters  $\alpha_1, \ldots \alpha_4$ ?
  - 1. Assume values for  $\alpha_1 \dots \alpha_A$
  - 2. Find patch-specific effort that satisfies equimarginal value
  - 3. Find associate value for each patch
  - 4. Compare prediction with data
  - 5. Repeat to choose  $\alpha_1, \ldots \alpha_4$  to optimize fit to data.



#### Summary

- To predict ecological effects of MPAs, we need a fleet model
- We'd like fleet model to: (1) accord with basic principles, (2) match effort distribution data under current conditions, (3) provide means of predicting fleet movement under any regional MPA proposal
- Our procedure generates a fleet model that is consistent with principles, existing data
  - But can also be used to forecast fleet changes under MPAs